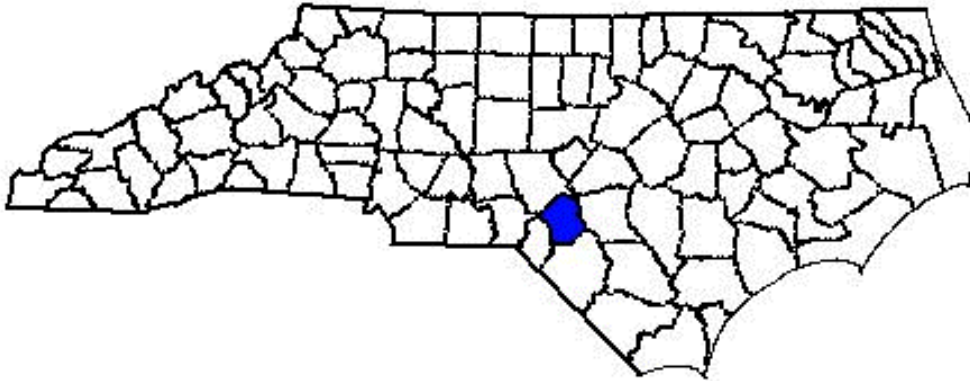


ANNUAL REPORT FOR 2002



**LONG SWAMP MITIGATION SITE
HOKE COUNTY
PROJECT NO. 8.589008T
TIP NO. R-512WM**



Prepared By:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
December 2002

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LONG SWAMP MITIGATION SITE 2002 REPORT – EXECUTIVE SUMMARY

The following report summarizes the monitoring activities that have occurred in the past year at the Long Swamp Mitigation Site. This site was constructed in 1998. Monitoring activities in 2002 represent the fourth year of monitoring following construction. The site must demonstrate hydrologic and vegetation success for a minimum of five years or until the project is deemed successful.

The site contains twenty groundwater monitoring gauges (four of which are in reference wetlands), one rain gauge, and eighteen vegetation plots. Rainfall data has been acquired from an onsite rain gauge. Also, monthly rainfall data recorded from a rain gauge maintained by the NC State Climate Office in Red Springs (Robeson County) was used for the historical data.

Based on the previous years of monitoring data, the Department re-evaluated portions of the proposed restoration areas on the site to identify problem areas and to determine if adjustments were warranted to improve hydrology. Based on the delineation, which was recently documented by written correspondence to the regulatory agencies, the Department determined that there is a 43.1 acre deficit, involving the areas restoration (prior-converted farm fields) at this site. The Department is soliciting additional wetland mitigation through the private sector “full delivery” program to compensate for this deficit, along with the additional 20 acres of restoration that the Long Swamp Site did not provide in relation to the environmental permit for the Rockingham-Hamlet Bypass (R-512).

2002 represents the fourth year of hydrologic monitoring. Of the non-reference monitoring gauges, two of the sixteen monitoring gauges met the optimum jurisdictional wetland hydrology for at least 12.5% of the growing season. Five of sixteen gauges met wetland hydrology for >5% of the growing season, while two of the four reference gauges met the optimum success criteria). Conversely, eleven gauges met hydrology less than 5% of the growing season. A decrease in groundwater levels was observed over all gauges across the site. This decrease is likely attributed to the below normal rainfall experienced in this region of the state throughout the 2002-growing season. The decline in optimum hydrology is attributed to the below average rainfall experienced in this region during the growing season.

The 2002 vegetation monitoring revealed an average density of 572 trees per acre. This average is well above the minimum success criteria of 290 trees per acre, required after 4 years of monitoring.

NCDOT proposes to continue both hydrologic and vegetation monitoring for this site in 2003.

1.0 Introduction

1.1 Project Description

The Long Swamp Wetland Mitigation Site is located approximately 8.7 miles southwest of Raeford in Hoke County (Figure 1). It is bounded by SR 1105 (Wire Road) to the north, SR 1108 (Wilson Road), and SR 1115 (Tom McLaughlin Road) on the west, although portions of the site extends south and west of these secondary roads. The site, located at the head of Long Swamp stream, is characterized as nearly level, encompassing minimal slopes associated with floodplain boundaries of low-energy streams, rims of Carolina bays, and intermittent sand ridges. The area was converted into agricultural use.

The site encompasses approximately 249 acres and is designed as a mitigation site primarily for the US 74 Bypass of Rockingham and Hamlet, TIP Project R-512 (USACE Action ID No. 199301490).

1.2 Purpose

In order to demonstrate successful mitigation, hydrologic and vegetative monitoring must be conducted for a minimum of five years or until success criteria are fulfilled. Success criteria are based on federal guidelines for wetland mitigation. These guidelines stipulate criteria for both hydrologic conditions and vegetation survival. The following report details the results of hydrologic and vegetative monitoring during 2002 at the Long Swamp Mitigation Site.

Activities in 2002 reflect the fourth year of monitoring following the construction. Included in this report are analyses of both hydrologic and vegetative monitoring results as well as local climate conditions throughout the growing season.

1.3 Project History

Summer 1998	Site Construction
March 1999	Installation of Monitoring Gauges
April 1999	Tree Planting
April 1999	Initial Vegetation Monitoring
March-November 1999	Hydrologic Monitoring (Year 1)
October 1999	Vegetation Monitoring (Year 1)
March 2000	Herbicide Treatment (Year 1)
March-November 2000	Hydrologic Monitoring (Year 2)
September 2000	Vegetation Monitoring (Year 2)
March-November 2001	Hydrologic Monitoring (Year 3)
September 2001	Vegetation Monitoring (Year 3)
June 2002	Wetland Delineation
August 2002	Vegetation Monitoring (Year 4)
March-November 2002	Hydrologic Monitoring (Year 4)

1.4 Permit Related Requirements

The entire Long Swamp Mitigation Site was used to offset unavoidable wetland impacts, as a result of the construction of the Rockingham-Hamlet Bypass roadway project.

2.0 HYDROLOGY

2.1 Success Criteria

In accordance with federal guidelines for wetland mitigation, the success criteria for hydrology states that the area must be inundated or saturated (within 12" of the surface) by surface or ground water for at least 12.5% of the growing season. Areas inundated less than 5% of the growing season are always classified as non-wetlands. Areas inundated between 5% - 12.5% of the growing season can be classified as wetlands depending upon factors such as the presence of hydrophytic vegetation and hydric soils.

The growing season in Hoke County begins March 17 and ends November 12. The dates correspond to a 50% probability that temperatures will drop to 28° F or lower after March 17 and before November 12.¹ The growing season is 239 days; therefore the optimum duration for wetland hydrology is 30 days. Local climate must represent average conditions for the area.

2.2 Hydrologic Description

Historically, wetlands on the tract were created by a combination of rainfall, runoff, and groundwater seepage from adjacent interstream areas, and redirected runoff via ditching. Local rainfall was contained within bays or was moved laterally to radially through the soil toward ditches or the remnant Long Swamp stream. After an extensive study of the site's hydrology, it was concluded that placement of impermeable plugs along drainage structures, backfilling of ditches and canals, and diversion of roadside ditches into restored wetlands would elevate the groundwater to a level that would saturate the soil stratum within the required twelve inches. It was predicted that this, in addition to surface water and runoff would be sufficient to restore wetland hydrology.

Fifteen groundwater monitoring gauges and one rain gauge were installed in 1999 (Figure 2). The automatic monitoring gauges record daily readings of groundwater depth.

Five additional gauges (G-17 through G-21) were installed in November 2000 to provide more groundwater data in the restoration areas.

This year, rainfall data has been acquired from an onsite rain gauge. Also, daily rainfall data recorded from a rain gauge maintained by the NC State Climate Office in Red Springs (Robeson County) was used for comparison.

¹ Natural Resources Conservation Service, Soil Survey of Hoke County, North Carolina, p.105.

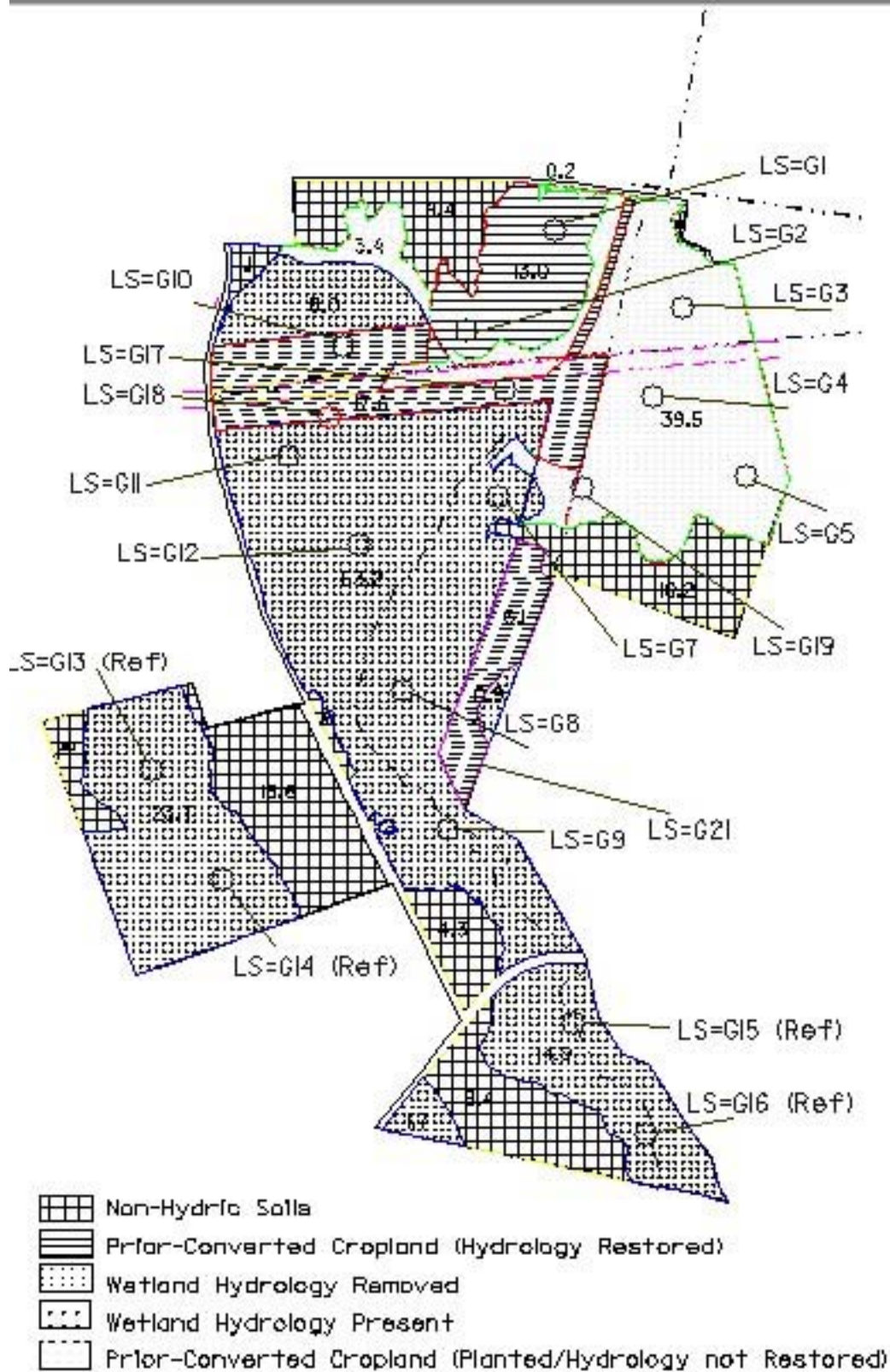


Figure 2: Monitoring Gauge Location Map

2.3 Results of Hydrologic Monitoring

2.3.1 Site Data

The maximum number of consecutive days that the groundwater was within twelve inches of the surface was determined for each gauge. This number was converted into a percentage of the 239-day growing season. Table 1 presents the 2002 results.

Appendix A contains a plot of the groundwater depth for each gauge. The maximum number of consecutive days is noted on each graph. The individual precipitation events, shown on the monitoring gauge graphs as bars, represent daily rainfall from an on-site rain gauge. Graph data determined to be erroneous was omitted; therefore, some gaps appear in the plots.

Figure 3 represents a graphical representation of the hydrologic results. Gauges highlighted in blue indicate wetland hydrology for more than 12.5% of the growing season. Gauges highlighted in red show hydrology between 8% and 12.5% of the season, while those in green indicate hydrology between 5% and 8% of the season. Gauges highlighted in black indicate no wetland hydrology (less than 5% of the growing season).

Table 1
2002 HYDROLOGIC MONITORING RESULTS

Monitoring Gauge	< 5% (<12 dy)	5 - 8% (12-18 dy)	8 - 12.5% (19-29 dy)	> 12.5% (>30 dy)	Actual %	Dates Meeting Success
LS-G1	✓				4.2	
LS-G2	✓				2.5	
LS-G3	✓				.4	
LS-G4	✓				0	
LS-G5	✓				.4	
LS-G7	✓				1.3	
LS-G8			✓		11.7	March 27-April 23
LS-G9				✓	18.8	March 17-April 30
LS-G10		✓			6.3	March 31-April 14
LS-G11				✓	15.9	March 17-April 23
LS-G12			✓		11.3	March 27-April 22
LS-G13*			✓		10.0	March 31-April 23
LS-G14*			✓		11.7	March 27-April 23
LS-G15*				✓	13.0	March 27-April 26
LS-G16*				✓	19.3	March 17-May 1
LS-G17^	✓				3.8	
LS-G18^	✓				4.6	
LS-G19^	✓				0	
LS-G20^	✓				0	
LS-G21^	✓				.8	

* Gauges in references wetlands areas, as was established in the mitigation planning report.

^ Gauges should be in a dry area according to the Mitigation Plan

Specific Gauge Problems:

- G-4 stopped recording data due to a gauge malfunction (February 9-May 14) (July 23-September 10)
- G-5 stopped recording data (July 23-September 10)
- G-9 stopped recording data (June 14-July 10)
- G-10 stopped recording data (April 15-May 14) (June 11-July 10). The gauge was missed during downloads (October 18- November 26)
- G-14 was not downloaded (October 18- November 26)
- G-17 had gauge malfunctions throughout the growing season beginning April 10.
- G-20 experienced battery failure (March 14-April 15). The gauge was missed during downloads (October 18-November 26)
- G-21 experienced battery failure (March 14-April 15)

During the growing season from March to November 2002, two of the sixteen gauges (non-reference gauges) met jurisdictional hydrologic success of at least 12.5% during

the growing season. Two gauges showed saturation between 8 and 12.5% of the growing season, while only one gauge showed saturation between 5-8%. Conversely, eleven gauges met hydrology less than 5% of the growing season. The decline in groundwater hydrology in 2002 is attributed to the below average rainfall experienced in this region of the state.

Of the four reference gauges, two showed saturation or inundation greater than 12.5% of the growing season within 12", while the other two showed saturation for between 8 and 12.5%. It is noted that even though the reference gauges met wetland hydrology, they all showed a decrease due to the below average rainfall experienced in this region of the state.

2.3.2 Climatic Data

Figure 4 is a comparison of monthly rainfall for the period of November 2001 through July 2002 to historical precipitation (collected between 1971 and 2002) for Hoke County. Monthly rainfall was not provided for October 2002-December 2002. This comparison gives an indication of how 2002 relates to historical data in terms of climate conditions. The NC State Climate Office at the Red Springs weather station provided all of the off-site rainfall data.

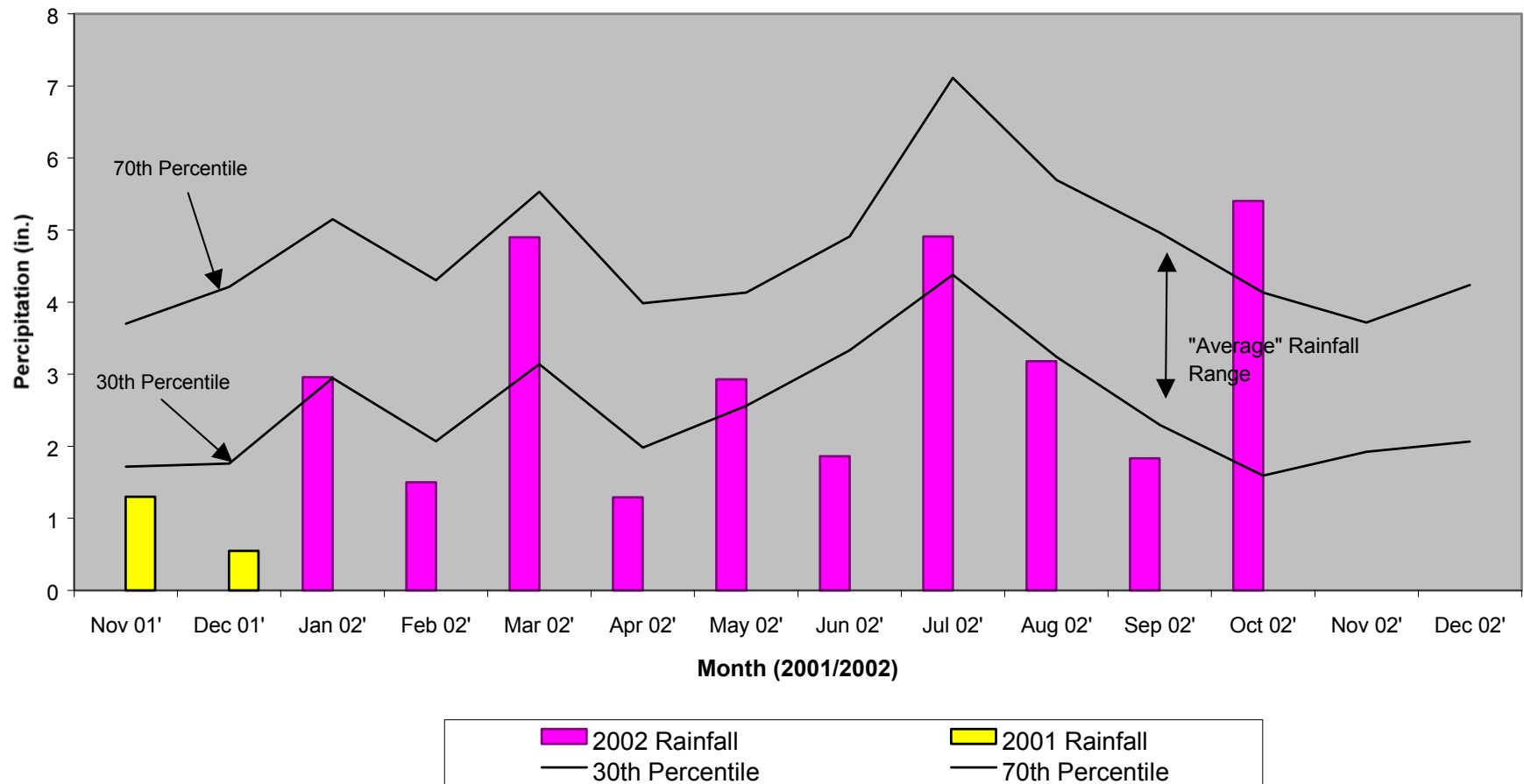
November 01, December 01, February, April, and June experienced below average rainfall. The months of January, March, May, and July all recorded average rainfall for the site. Overall the site experienced below average rainfall in 2002.

2.4 Conclusions

2002 represents the fourth full growing season that the hydrologic data has been monitored. Of the non-reference monitoring gauges, two of the sixteen monitoring gauges met the optimum jurisdictional wetland hydrology for at least 12.5% of the growing season. Five of sixteen gauges met wetland hydrology for >5% of the growing season, while two of the four reference gauges met the optimum success criteria). Conversely, eleven gauges met hydrology less than 5% of the growing season. The decrease in groundwater levels was observed over all gauges across the site. This decrease is likely attributed to the below normal rainfall experienced in this region of the state throughout the 2002-growing season.

A portion of the proposed restoration areas at the site that have performed less than expected were evaluated and quantified this growing season. Based on the results of the delineation, the Department is in need of a total of 63.1 acres of restoration to offset the 43.1-acre deficit at the Long Swamp site and to compensate for the additional 20 acres needed to fulfill the permit requirements for the Rockingham-Hamlet Bypass (R-512).

**FIGURE 4: Long Swamp 30-70 Percentile Graph
Hoke County**



3.0 VEGETATION (MONITORING YEAR 4 OF 5)

3.1 Success Criteria

NCDOT will monitor the site for five years or until success criteria is met. A 320 stems per acre survival criterion for planted seedlings will be used to determine success for the first three years. The required survival criterion will decrease by 10% per year after the third year of vegetation monitoring (i.e., for an expected 290 stems per acre for year 4, and 260 stems per acre for year 5). A minimum of 5 character tree species must be present, with no more than 20% of any one species is also required with the exception of Atlantic White Cedar which may comprise up to 75% in swamp forest restoration. Loblolly Pine cannot comprise of more than 10% of the 320 trees per acre requirement.

3.2 Description of Species

The following species were planted in the Wetland Restoration Area:

Zone 1: Streamhead Pocosin (2 acres)

Taxodium distichum, Baldcypress
Chamaecyparis thyoides, Atlantic White Cedar
Liriodendron tulipifera, Tulip Poplar
Pinus serotina, Pond Pine
Quercus laurifolia, Laurel Oak
Fraxinus pennsylvanica, Green Ash
Magnolia virginiana, Sweet Bay
Quercus lyrata, Overcup Oak
Quercus phellos, Willow Oak
Quercus michauxii, Swamp Chestnut Oak
Quercus falcata var. *pagodaefolia*, Cherrybark Oak
Nyssa sylvatica, Blackgum
Quercus alba, White Oak

Zone 2: Streamhead Atlantic White Cedar (4.4 acres)

Chamaecyparis thyoides, Atlantic White Cedar
Liriodendron tulipifera, Tulip Poplar
Pinus serotina, Pond Pine
Fraxinus pennsylvanica, Green Ash

Taxodium distichum, Bald Cypress

Zone 3: Non-riverine Wet Hardwood Forest (74.4 acres)

Quercus michauxii, Swamp Chestnut Oak

Quercus laurifolia, Laurel Oak

Quercus nigra, Water Oak

Quercus lyrata, Overcup Oak

Quercus phellos, Willow Oak

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Fraxinus pennsylvanica, Green Ash

Zone 4: Coastal Plain and Small Stream Swamp (42 acres)

Taxodium distichum, Bald Cypress

Quercus phellos, Willow Oak

Quercus laurifolia, Laurel Oak

Quercus lyrata, Overcup Oak

Quercus michauxii, Swamp Chestnut Oak

Liriodendron tulipifera, Tulip Poplar

Fraxinus pennsylvanica, Green Ash

Nyssa sylvatica, Blackgum

**Zone 5: Mesic Mixed Hardwood Forest (Coastal Plain Subtype)
(43.8 acres)**

Quercus lyrata, Overcup Oak

Quercus alba, White Oak

Quercus rubra, Northern Red Oak

Quercus nigra, Water Oak

Quercus falcata var. *pagodaefolia*, Cherrybark Oak

Quercus michauxii, Swamp Chestnut Oak

Quercus phellos, Willow Oak

Quercus laurifolia, Laurel Oak

3.3 Results of Vegetation Monitoring

Table 3

2002 VEGETATIVE MONITORING RESULTS

	Plot #	Overcup Oak	White Oak	Northern Red Oak	Water Oak	Swamp Chestnut Oak	Cherrybark Oak	Willow Oak	Laurel Oak	Green Ash	Atlantic White Cedar	Pond Pine	Blackgum	Baldcypress	Tulip Poplar	Sweet Bay	Total (4 year)	Total (at planting)	Density (Trees/Acre)
Zone 1	9	6	1			3	1	1	1			8	2				23	48	326
ZONE 1 AVERAGE DENSITY																			326
Zone 2	5				7	1		1			8	20					37	37	680
ZONE 2 AVERAGE DENSITY																			680
Zone 3	2	1			3			12	5								21	30	476
	3					14	6	11	3	0							34	35	661
	4	8				4	5		10	2							29	32	616
	6	5				7		3		11							26	26	680
	7	9				6	8		3	4							30	40	510
	17	2			7	10		7	3	7							36	45	544
	18	6				8		1		2							17	26	445
ZONE 3 AVERAGE DENSITY																			562
Zone 4	10					6				7			11	4			28	35	544
	11	6				8		6		4			3	7			34	37	625
	12	4				6							12	15			37	38	662
	13					11				2			3	7	8		31	31	680
ZONE 4 AVERAGE DENSITY																			628
Zone 5	1	4		1		14	12		1								32	38	573
	8		2	8		6	3	1	5								25	40	425
	14			4	5	10			6								25	29	586
	15			1		14	14	1	4								34	39	593
	16	14	2	17		1	4	1	5								44	45	665
ZONE 5 AVERAGE DENSITY																			568
TOTAL AVERAGE DENSITY																			572

Site Notes: Monitoring of vegetation plots in upland areas (Plots 1, 8, 14, 15, and 16) has been discontinued as discussed and agreed upon during the May 29, 2002 site visit.

Zone 1	Other species: Sweetgum, wax myrtle, <i>Baccharis</i> sp., broomsedge, winged sumac, muscadine, blackberry, American holly, and briars. Tulip poplar noted outside of plot 9.
Zone 2	Other species: Sweetgum, fennel, winged sumac, volunteer post and water oak, and briars.
Zone 3	Other species: Pine, sickle pod, red maple, bermuda, broomsedge, smartweed, briars, woolgrass, stinkweed, sweetgum, volunteer blackgum, plume grass, fern, black willow, hickory, trumpet creeper, winged sumac <i>Smilax</i> sp., cattail, and fennel.
Zone 4	Other species: Sweetgum, briars, broomsedge, holly, sourwood, bay, volunteer black gum, <i>Baccharis</i> sp., wax myrtle, black willow, red maple, volunteer tulip poplar, and pine.

3.4 Conclusions

Of the 249 acres on this site, approximately 167 involved tree planting. There were 18 monitoring plots established throughout the planting areas, encompassing all plant communities. The 2002 vegetation monitoring revealed an average density of 572 trees per acre. This average is well above the minimum success criteria of 290 trees per acre, after 4 years.

NCDOT will continue vegetation monitoring at the Long Swamp Mitigation Site.

4.0 OVERALL CONCLUSIONS/ RECOMMENDATIONS

Based on the hydrologic monitoring at the site in 2002, nine of the twenty monitoring gauges met jurisdictional wetland status. The decline in the performance of the remaining gauges is attributed to the below average rainfall experienced.

The 2002 vegetation monitoring revealed an average density of 572 trees per acre. This average is well above the minimum success criteria of 290 trees per acre.

Based on the results on the site evaluation in 2002, the Department has solicited additional wetland mitigation to offset deficiencies at the Long Swamp site and to offset the additional acreage needed to fulfill the permit requirements of the Rockingham-Hamlet Bypass (R-512).

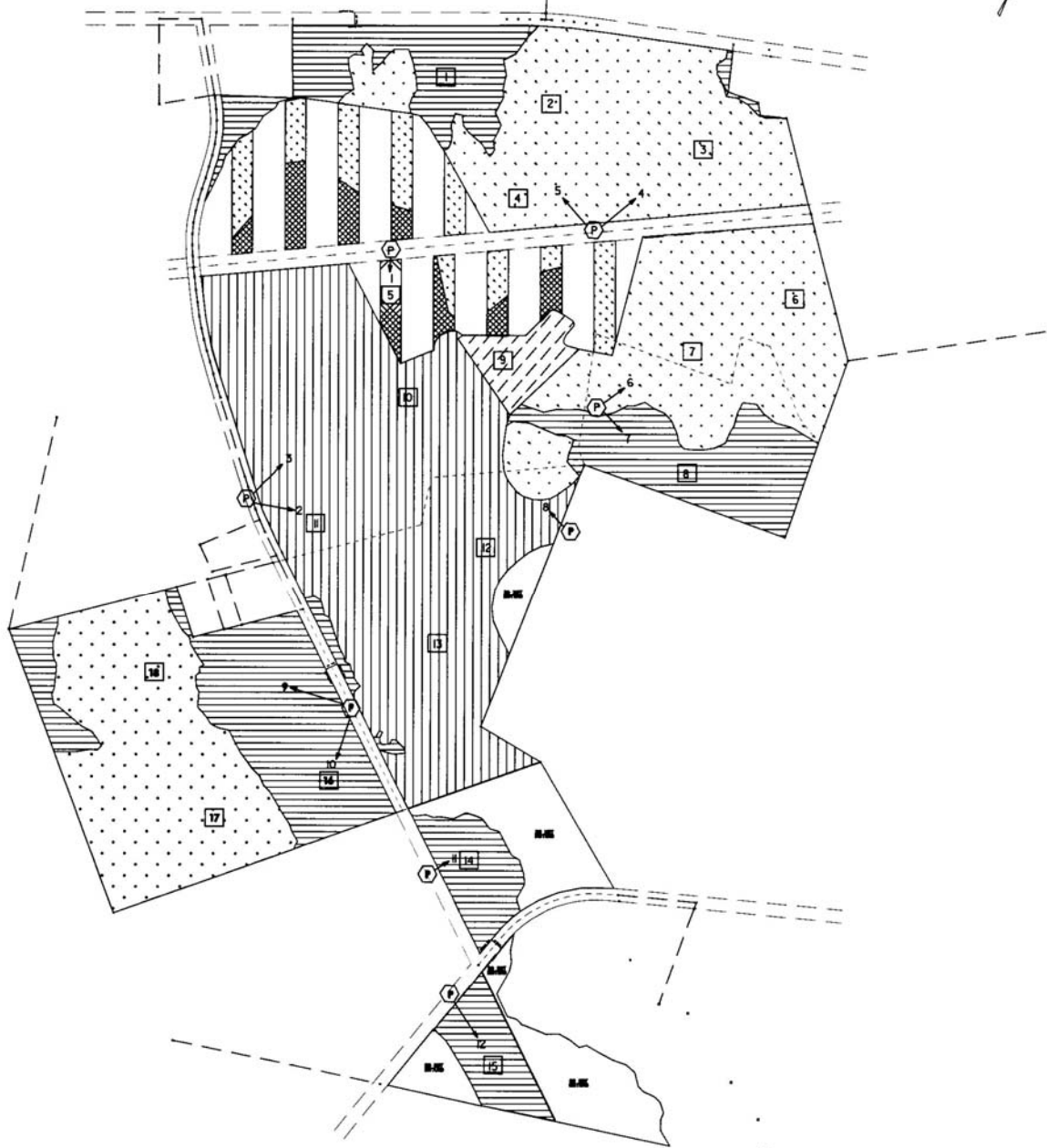
APPENDIX A

DEPTH TO GROUNDWATER GRAPHS

APPENDIX B

PHOTO AND VEGETATION PLOT LOCATIONS, SITE PHOTOS

LONG SWAMP MITIGATION SITE PHOTO AND PLOT LOCATIONS



HECTARES		NO PLANTING
1.2		STREAMHEAD POCOSIN
0.9		STREAMHEAD ATLANTIC WHITE CEDAR
32.4		NON RIVERINE WET HARDWOOD FOREST
22.0		COASTAL PLAIN AND SMALL STREAM SWAMP
18.1		MIXED MESIC HARDWOODS

MONITORING PLOTS
 PHOTO LOCATIONS

• QUANTITIES REPRESENTATIVE OF ENTIRE SITE

Scale 1" = 100'

PROJECT: LONG SWAMP MITIGATION
 DATE: 10/1/88
 PREPARED BY: J. L. HARRIS
 FOR: U.S. ARMY CORPS OF ENGINEERS
 WATKINSVILLE DISTRICT
 WATKINSVILLE, GA.

U.S. ARMY CORPS OF ENGINEERS
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Long Swamp



Photo 1



Photo 2



Photo 3



Photo 4



Photo 5



Photo 6

Long Swamp



Photo 7



Photo 8



Photo 9



Photo 10



Photo 11



Photo 12